UBC Math 516: **Partial Differential Equations I**, 2025W1

This course is an introduction to the qualitative theory of partial differential equations. The emphasis is on linear elliptic and parabolic problems, especially their weak solutions in function spaces like Sobolev spaces. It should be useful to students with interests in applied mathematics, differential geometry, mathematical physics, probability, harmonic analysis, or dynamical systems, as well as to PDE-focused students.

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Rough Course Outline (subject to possible tweaks):

- **Classical linear equations** (2-3 weeks): the Laplace, heat, and wave equations, and their fundamental solutions; properties of solutions: mean value properties, regularity, maximum principles, uniqueness for boundary (and initial) value problems
- **Second-order linear elliptic equations** (3-4 weeks): weak solutions; regularity; maximum principles
- **Second-order parabolic equations** (3-4 weeks): weak solutions; regularity; maximum principles; semigroup theory
- **Further topics** (2-4 weeks), chosen from among: L^p theory: Calderon-Zygmund inequality; Schauder theory: Hölder estimates, method of continuity; DeGiorgi-Nash-Moser theory
- **Analytical tools** we will review/expose along the way as needed: definitions and properties of L^p and Sobolev spaces; the Fourier transform; compactness and weak convergence; etc.

References: a list of helpful texts will be maintained on the course Canvas site, but our basic reference is

- *Partial Differential Equations*, by Lawrence C. Evans, AMS (any edition).

Pre/co-requisites: some integration theory and functional analysis (e.g. UBC Math 420/421 or equivalent) would be helpful, as would some previous exposure to PDE.

Grading: is based on homework assignments.

Course information and policies: will appear on the course Canvas site.

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